WHY DO ALL THE PLANETS OF OUR SOLAR SYSTEM, ELECTRONS AND NUCLEONS ETC. ALL POSSESS SPIN MOTION

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All the planets of our solar system, electrons and nucleons etc. all possess spin motion. It cannot be a matter of coincidence or chance. There must positively be some purpose/reason behind it. Presently, that purpose/reason has been determined, and taking account of that purpose/reason, the phenomena related with electrons and nucleons etc. have been tried to explain. Surprisingly, the account of the determined purpose/reason enables to give very clear and complete explanation of all the phenomena related with them, structures and properties of systems constituted by them, even of so far unexplained phenomena: 1. Despite moving in spherically symmetric field, how do the orbiting electrons acquire elliptical orbits? 2. What is source/cause that keeps them going on spinning and moving in their elliptical orbits persistently while their paths are not happened to be equipotential because of being elliptical? 3. How do their energy, momentum, spin angular momentum etc. conserve, because when they move along their elliptical orbital paths, their velocity varies? Presently, it has also been determined as to how electrons and nucleons etc. obtain spin motion and how their spin motion persists.

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1. INTRODUCTION

We know that all the planets of our solar system, electrons and nucleons etc. all possess spin motion. It cannot be a matter of coincidence or chance. There must positively be some purpose or reason behind it and that should be determined. But that has not been determined yet. Presently, that purpose/reason has been determined (see Sec. 2). Presently, it has also been determined as to how electrons, nucleons and photons etc. obtain spin motion and how their spin motion persists (see Sec. 3).

Taking account of that purpose/reason, the phenomena related with electrons, nucleons and photons etc. have been tried to explain. (The photons also possess spin motion, and ν, which we define as the frequency of the wave nature of photons, is in fact the frequency of spin motion of photons that they derive from the orbiting electrons, the photons are emitted from. For its confirmation, see Sec. I A, Ref. 1.) Surprisingly, the account of the determined purpose/reason enables to give very clear and complete explanation of all the phenomena related with them, structures and properties of systems constituted by them. For example: 1. Spectroscopic phenomena (see Sec. 4.1.1); 2. Quantum mechanical phenomena (see Sec. 4.1.2); 3. Phenomena of interference and diffraction (see Sec. 4.1.3); 4. Relativistic phenomena (see Sec. 4.1.4); 5. Phenomenon of electromagnetism and the related properties generated in electron beams and current carrying rods (see Sec. 4.2.1); 6. Phenomenon of superconductivity and the related properties and effects (see Sec. 4.2.2); 7. Nuclear phenomena, structures and properties of neutrons, deuterons, alpha particles and nuclei (see Sec. 4.2.3). The account of the determined purpose/reason enables to give very clear and complete explanation also of: 1. Despite moving in spherically symmetric field, how do

the orbiting electrons acquire elliptical orbits? 2. What is source/cause that keeps them going on spinning and moving in their elliptical orbits persistently while their paths are not happened to be equipotential because of being elliptical? 3. How do their energy, momentum, spin angular momentum etc. conserve, because when they move along their elliptical orbital paths, their velocity varies? [See Sects. III C and J, Ref. 1]

2. DETERMINATION OF WHY DO ALL THE PLANETS OF OUR SOLAR SYSTEM, ELECTRONS AND NUCLEONS ETC. ALL POSSESS SPIN MOTION

The spin motion of every particle/body actually generates two greatly important properties in it (see Sec. 2.1). And hence, in all the planets, electrons and nucleons etc. too, these properties are generated. How much important these two generated properties are, see Sects. 4.1 and 4.2.

If the spinning particles possess magnetism, e.g. electrons, protons, neutrons etc., the generated two properties in them, enable them to create such situation that due to interaction between their magnetic fields, a strong, short range and charge independent force is generated between them (see Sec. 2.2). This generated force has both the components, attractive and repulsive. How much important this generated force is, see Sects. 2.2 and 4.2.

2.1. The two properties which are generated in particles due to their spin motion

The following two properties are generated in particles due to their spin motion.

2.1.1 First property

The spin motion of particle generates the tendency of linear motion in it along the direction of its spin angular momentum L_S (for verification of its truth, see Sec. I B, Ref. 1). Consequently, every spinning particle, e.g. electron, nucleon and photons etc. possesses direction of its linear motion. By some means, e.g. applying some external electric or magnetic field on electrons, protons etc, if the particles are made able to move, the directions of L_S of the particles are oriented and aligned in direction according to Lorentz force and then they start moving along that direction (for confirmation that the directions of L_S, i.e. the directions of motion of the particles are oriented and aligned if electric or magnetic field is applied across them, see Sec. 4.4, Ref. 2 and also Sec. 5.4.1, Ref. 3).

2.1.2 Second property

If the frequency of spin motion of the particle is increased by some means, a stage comes when the particle starts moving itself along the direction of its L_S. Then after, as the frequency of spin motion of the particle increases, the velocity of particle, e.g., electron, proton etc. goes on increasing in accordance to expression

$$\mathrm{v}^2 = h\omega / m \qquad \text{.....} \qquad (1)$$

where m, v and ω respectively are the mass, linear velocity and frequency of spin motion of particle and h is Planck's constant [for verification of the truth of expression (1), see Sec. I A, Ref. 1].

Due to spin motion, the particle obtains spin energy ($E_s = h\omega/2$, for detail, see Sec. II, Ref. 1), and due to its spin energy, it obtains spin momentum ($p_S = h\omega/\mathrm{v}$, for detail, see

Sec. II, Ref. 1) similarly as, due to its linear motion, it obtains kinetic energy (E_k), and due to its kinetic energy, it obtains linear momentum (p_{lin}). [For verification of the truth of that the spinning particles possess p_S , we can see Sec. I C, Ref. 1, and also can see the example of $h\nu/c$ of photons, which ($h\nu/c$) is in fact p_S of photons (for its confirmation and detail, see 2.2, Ref. 4).]

Therefore, the particles possessing linear motion together with their spin motion, they possess motional energy (E_m) = $E_k + E_s$, and motional momentum (p_m) = $p_{\text{lin}} + p_S$. And whenever comes the situation of conservation of energy and momentum of such particles, their E_m , p_m and L_S actually conserve, not their E_k and p_{lin} . [For verification of the truth of conservation of p_m , see Sec. I D, Ref. 1. And for, how E_m , p_m and L_S are conserved, see Sec. 4.1.4(a1).] Due to conservation of E_m , p_m and L_S of such particles, no violation of the laws of conservation of their energy and momentum etc. happens to be possible. For example:

1. During the motion of electron accelerated by a large voltage, after attaining relativistic velocity by it when the rate of increase in its velocity starts decreasing, there is created such situation that the rate of increase in its frequency of spin motion starts increasing which causes increase in its E_s and p_S . The increase in its E_s and p_S compensates the decrease in its E_k and p_{lin} and thus E_m and p_m of electron are conserved and no violation of the laws of conservation of energy and momentum take place [for detail, see Sec. 4.1.4(a)].

2. During the motion of electron along its elliptical orbit when its velocity varies, E_k and p_{lin} of electron also vary accordingly. Then ω of electrons varies such that the variations caused in its E_s and p_S due to variation in its ω may balance the loss/gain occurred in its E_k and p_{lin} due to variation in its velocity. And thus E_m and p_m of electron are conserved.

NOTE: During the motion of electrons along their elliptical orbits, and during the motion of electrons after attaining relativistic velocity by them, the variation between their velocity (v) and frequency of spin motion (ω) does not take place according to expression (1) but that is changed. The changed form has not been determined but under way of determination.

2.2. The force that is generated between the spinning particles possessing magnetism

If the spinning particles possess magnetism, e.g. electrons, protons, neutrons etc., the generated two properties in them enable them to create such situation that due to interaction between their magnetic fields, a strong, short range and charge independent force is generated between them. This generated force happens to be attractive or repulsive depending upon the positions of the interacting particles. As the positions of the interacting particles take place, accordingly attractive or repulsive type of force is generated between them.

How the attractive force is generated between the spinning particles possessing magnetism, e.g., between two electrons, see Sec. 4.1, Ref. 5, and how the magnitude of the generated force varies as the distance between them varies; see Sec. 6.1, Ref. 5. How the

repulsive force is generated between the spinning particles possessing magnetism, e.g., between two electrons, see Sec. 4.2, Ref. 5, and how the magnitude of the generated force varies as the distance between them varies; see Sec. 6.2, Ref. 5.

Due to attractive force, electrons, protons, neutrons etc. are all held together in their respective beams against the repulsive Coulomb force between them. [How these particles (e.g. electrons) are held together in their respective beams, see Sec. 5, Ref. 5.] In neutron beams, since neutrons start decaying after their mean life time (about 15 minutes), the neutron beams do not survive as electron and proton beams survive. They (neutron beams) are destroyed shortly.

Due to interaction between magnetic fields of electrons, electromagnetism (diamagnetism) and magnetic field too are generated in the beam and around the beam respectively, see Sec. 5, Ref. 5. The generated magnetic field around the beam possesses anticlockwise direction (if the motion of the beam is towards the face of the clock) and occurs in plane perpendicular to the direction of motion of the beam; see Sec. 5, Ref. 5. In existence, no explanation is available as to: 1. Why and how electrons, protons etc., are held together in their respective beams despite having repulsive Coulomb force between them; 2. How magnetic field is generated in a plane perpendicular to the direction of motion of beam and how that field possesses direction (anticlockwise); 3. How and which type of magnetism is generated in the beam.

The attractive force generated between nucleons enables to give almost a complete understanding about the structures, properties etc. of deuterons, alpha particles and nuclei (for detail, see Sec. 4, 5, 6, 7, 8 and 9, Ref. 6).

The repulsive force generated between nucleons enables to give the complete knowledge as to how the emission of alpha (α) and beta (β) particles takes place from nuclei (for detail, see Sec. 9.2, Ref. 6).

Currently, we know about the Yukawa's force of attraction[7] acting between nucleons. According to his meson field theory, a field of virtual π mesons is assumed between the nucleons in nuclei and due to their continuous exchange between the nucleons, the nuclear force is assumed to be generated. But it gives rise to numerous very fundamental questions. For example: 1. Virtual means which does not exist physically, then how can the field of such (i.e. virtual) π mesons occur? 2. How can such π mesons possess charge, that too positive or negative? 3. The real π mesons possess charge and mass both, while to virtual π mesons, only charge has been assigned and mass has not been assigned, why is this double standard or inconsistency? 4. As far as the author's knowledge is concerned, it is believed that there exist only matter and energy in the universe which are inter-convertible, in which category, matter or energy, do the virtual π mesons lie?

Further, does the field of virtual π mesons occur in proton and neutron beams and they (protons and neutrons) are held together against the repulsive Coulomb force in their respective beams due the continuous exchange of virtual π mesons between them? If not, then:

1. Why is this inconsistency? When the field of virtual π mesons can occur in nuclei, it should occur in proton and neutron beams too because these are also nucleons.

2. How electrons, protons etc. are held together in their respective beams against the repulsive Coulomb force?

And if yes, then:

1. The field of virtual π mesons should occur in electron beams too, and due to the exchange of π mesons between electrons, the electrons should be held together in electron beams. Can it happen so? If not, then how are the electrons held together in their beams?

2. The neutron beams should exist in nature similarly as nuclei exist in nature, and even with more strong stability. Because, in neutron beams, there occur no protons and hence no repulsive Coulomb force comes into play. But on the contrary, the neutron beams do not survive even as long as the proton beams survive. Here some people may argue, it happens because neutrons start decaying after their mean life time and consequently neutron beams are destroyed. This argument is true but it gives rise to questions: Then why and how do neutrons not decay in deuterons (D), alpha particles (α) and nuclei? What does happen in D, α and nuclei such that the neutrons in them stop decaying and become stable? Do neutrons become stable in D, α and nuclei due to the presence of proton(s) in them? If yes then how? Further, If one more proton is added in D, the resultant system (i.e. He^3) becomes more stable, while if one more neutron is added in D, though the binding energy per nucleon (E_b) of the resultant system (i.e. H^3) is increased in comparison to that of the system He^3 but the system (i.e. H^3) becomes unstable and decays into He^3 through β decay. Despite $(E_b)_{H^3} > (E_b)_{He^3}$ [where $(E_b)_{H^3}$ is the binding energy per nucleon in the nucleus of H^3 and $(E_b)_{He^3}$ is the binding energy per nucleon in the nucleus of He^3], why and how does H^3 decays into He^3? If one neutron is added in He^3 or one proton in H^3, the resultant system (i.e. α particle) becomes so strongly stable that it starts behaving like a

particle. While if one proton is added in He^3 or one neutron in H^3, the resultant systems, i.e. isotope Li^4 (half life time = 9.1×10^{-23} s) and isotope H^4 (half life time = 1.39×10^{-22} s) respectively become extremely unstable. (The isotope Li^4 is though found in nature but the isotope H^4 is not found in nature. It is obtained by synthesis.) How?

In existence, no explanation is found of any of the above phenomenon/event. The presently determined force generated between nucleons gives very clear and complete explanation of each and every phenomenon/event mentioned above, and also of why and how the systems, di-proton and di-neutron do not exist in nature despite the existence of these is theoretically possible (see Sects. 4, 5, 6, Ref. 6).

3. DETERMINATION OF HOW DO ALL THE PLANETS OF OUR SOLAR SYSTEM, ELECTRONS AND NUCLEONS ETC. ALL POSSESS PERSISTENT SPIN MOTION

Presently, for electrons, protons, neutrons etc. it has been determined as to how despite these do not have any source or reservoir of infinite energy for their persistent spin motion, these possess persistent spin motion.

3.1 How electrons possess persistent spin motion

The current concept that due to spin motion of charge of electrons, electrons possess magnetism, magnetic field and spin magnetic moment (μ_s), is not true (for its confirmation, see Sec. 1, Ref. 2). The electrons possess a bundle of magnetism by the virtue of nature similarly as they possess a bundle of charge (– e) by the virtue of nature. The magnetism occurs in the form of a circular ring round the charge of electron where the charge occurs in the form of a ball (for detail, see Sec. 2, Ref. 2).

When the electron possesses charge and magnetism both, obviously their fields interact, i.e. electromagnetic interaction. But, since the charge and magnetism of electron exist together and these are not repelled by each other, the interaction between their fields should be attractive. The attractive type of interaction between their fields can be possible if both the charge and magnetism of electron spin but in directions opposite to each other. And due to their spin motion, electron obtains electric and magnetic moments respectively which lie along the directions of their respective spin angular momentum, because then magnetic and electric moments of electron shall lie in directions opposite to each other. [Over the concept of electric moment of electron, people may express doubt, because in existence, there is no evidence of its occurrence. But its occurrence cannot be ruled out. There may be some cause due to which it could not have been observed yet. Somehow, determining that cause if it is tried to determine, it can be determined.]

The above assumptions cannot be ruled out because we observe that when two bar magnets are placed parallel to each other one upon the other with their magnetic moments in directions opposite to each other, the interaction between their magnetic fields happens to be attractive and the magnetism of both the bar magnets do not decay but remain intact. In the case of electrons too, no decay in their charge and magnetism takes place and these remain intact.

The interaction between the field of charge and the field of magnetism of electron keeps the charge and magnetism of electron spinning persistently. And the magnetic moment that arises due to spin motion of magnetism of electron and lies along the

direction of spin angular momentum of magnetism of electron happens to be μ_s, currently defined as spin magnetic moment of electron.

The frequencies of spin motion of the ball of charge (ω_{EC}) and the ring of magnetism (ω_{EM}) of electron are happened to be such that the generated spin angular momentum (L_{SC}) and the generated linear velocity (v_{EC}) in the charge of electron along the direction of its L_{SC} are greater than the generated spin angular momentum (L_{SM}) and the generated linear velocity (v_{EM}) in the magnetism of electron along the direction of its L_{SM}, i.e. $L_{SC} > L_{SM}$ and $\mathrm{v}_{EC} > \mathrm{v}_{EM}$. (The velocities v_{EC} and v_{EM} in the ball of charge and the ring of magnetism respectively are generated because of generation of two properties in them due to their spin motion, see Sec. 2.) The spin angular momentum L_S, which the electron as whole possesses, happens to be the resultant of L_{SC} and L_{SM}, i.e. $L_S = L_{SC} - L_{SM}$. Consequently, the electron possesses linear velocity v_E along the direction of its L_S and the magnitude and direction of its v_E vary as the frequencies of spin motion ω_{EC} and ω_{EM} vary. The frequency ω_E corresponding to the resultant spin angular momentum L_S, can be said to be the frequency of spin motion of electron.

Further, since μ_s occurs along the direction of L_{SM} and the electron possesses its linear velocity v_E along the direction of its L_S which (L_S) lies along L_{SC}, μ_s lies in direction opposite to the direction of L_S because L_{SC} and L_{SM} lie in directions opposite to each other.

3.2 How protons possess persistent spin motion

The protons too possess magnetism by the virtue of nature similarly as electrons possess, and it occurs in the form of a circular ring round the charge of proton which (charge of proton) occurs in the form of a ball. In the case of proton, since its mass happens to be much greater than that of electron despite having the same amount of charge ($+e$) as the electron possesses ($-e$), the ball probably possesses some material or something other than charge too in addition to charge ($+e$). The ball of charge and magnetism of proton too spin in directions opposite to each other similarly as occurs in the case of electron. And the interaction between the fields of charge and magnetism of proton keeps the charge and magnetism of proton going on spinning persistently.

The term μ_s, currently defined as spin magnetic moment of proton, arises due to spin motion of magnetism of proton and occurs along the direction of its spin angular momentum (L_{SM}).

The frequencies of spin motion of the ball of charge (ω_{PC}) and of the ring of magnetism (ω_{PM}) of proton are happened to be such that the generated spin angular momentum (L_{SC}) and linear velocity (v_{PC}) in the charge of proton along the direction of its L_{SC} are greater than the generated spin angular momentum (L_{SM}) and linear velocity (v_{PM}) in the magnetism of proton along the direction of its L_{SM}, i.e. $L_{SC} > L_{SM}$ and $\mathrm{v}_{PC} > \mathrm{v}_{PM}$. The spin angular momentum L_S, which the proton as whole possesses, happens to be the resultant of L_{SC} and L_{SM}, i.e. $L_S = L_{SC} - L_{SM}$. Consequently, proton possesses linear velocity v_P along the direction of its L_S and the magnitude and direction of its v_P

vary as the frequencies of spin motion ω_{PC} and ω_{PM} vary. The frequency ω_P corresponding to the resultant spin angular momentum L_S, can be said to be the frequency of spin motion of proton.

Further, since the magnetism of proton possesses magnetic moment (μ_s) along the direction of its L_{SM} and the proton possesses its linear velocity (v_P) along the direction of its L_S which (L_S) lies along L_{SC}, the proton possesses magnetic moment (μ_s) in the direction opposite to the direction of its L_S because L_{SC} and L_{SM} lie in directions opposite to each other.

3.3 How neutrons possess persistent spin motion

How neutrons possess spin motion, see the neutron model (Sec. 2, Ref. 8).

3.4 How photons possess persistent spin motion

The frequency ν, which is currently being defined as frequency of the wave nature of photons, is in fact the frequency of their spin motion. How and from where do the photons obtain their spin motion, see Sec. IV A, Ref. 1.

3.5 Importance of concepts taken in determination of as to how electrons, nucleons etc. all possess persistent spin motion

The present concept of spin motion of charge and magnetism of electron and proton in directions opposite to each other is though hard to accept but it cannot be ruled out because: i. The arguments given to justify the present concept cannot be ruled out. Ii. The present concept enables to resolve numerous mysterious but very important problems. For example:

1. Why and how neutron survives for about 15 minutes (mean life time of neutron) and then decays, while the rest of all the unstable elementary particles decay within fraction of second (see sec. 3.2, Ref. 8).
2. Why and how neutron has unstable and stable both the states, while the rest of all the elementary particles have only one state, either stable or unstable (see Sec. 3.3, Ref. 8).
3. Why neutron happens to be unstable in its free state, and how it becomes stable in systems, deuterons, α particles, and nuclei (see Sects. 4, 5, 6, Ref. 6).
4. How neutron possesses magnetic moment = - 0.00966236×10^{-24} J/T (see Sec. 3.4, Ref. 8).
5. While it is believed that the electrons do not reside inside the nuclei, then why and how the electrons are emitted from the nuclei during β decay (see Sec. 3.6, Ref. 8).
6. Why and how energy of the emitted β particles varies in the form of a continuous energy spectrum (see Sec. 3.7, Ref. 8).
7. Why and how neutrons have high penetrating power and distinguishable low and high-energy ranges (see Sects. 3.8 and 3.9, Ref. 8).
8. The reality of anti-particles, i.e. what these are actually and how these are produced. From where these are produced is known but how these are produced is yet not known. (Its complete information shall be given very shortly.)

4. IMPORTANCE OF THE ACCOUNTS OF THE GENERATED TWO PROPERTIES AND THE GENERATED FORCE

4.1 Importance of the account of the generated two properties

The account of the generated two properties in orbiting electrons due to their spin motion: 1. Resolves all the three very important but so far unresolved problems mentioned

above in Sec. 1 (see Sects. III C and J, Ref. 1). 2. Enables to give very clear and complete explanation of almost all the phenomena of spectroscopy, including several such phenomena/events which could not have been explained yet (see Sec. 4.1.1)

The account of two properties generated in free electrons, nucleons, photons etc. enables to explain all the phenomena related with them, e.g., quantum mechanical phenomena (see Sec. 4.1.2), the phenomena of interference and diffraction of photons and electrons (see Sec. 4.1.3) and the relativistic phenomena (see Sec. 4.1.4).

4.1.1 Explanation of spectroscopic phenomena

4.1.1 (a) Present explanation (i.e. taking account of the generated two properties in orbiting electrons**)**

The account of the generated two properties in orbiting electrons enables to, e.g.:

1. Deduce the expressions for both frequency of spectral lines (see Sec. III E, Ref. 1) and intensity of spectral lines (see Sec. III F, Ref. 1).
2. Explain how and why the intensity of spectral lines decreases as their frequency increases (see Sec. III H, Ref. 1).
3. Explain how and why the thickness of spectral lines decreases as their order increases (see Sec. III L, Ref. 1);
4. Give very clear and complete picture of why and how the fine structures of spectral lines are obtained (see Sects. III I and J, Ref. 1);
5. Deduce the expressions for number of fine lines in different spectral lines, for their frequency and intensity (see Sec. III K, Ref. 1).

The account of the generated two properties in orbiting electrons enables to explain several such phenomena/events too which are equally valuable and important, but their no explanations are available. For example:

1. How the radiation energy is emitted from the orbiting electrons in the form of bundles that provides physical existence to photons as particles, and how those bundles obtain energy $h\nu$ that enables photons to travel with velocity c, scatter electrons colliding with them in Compton scattering etc. (see Sec. III B, Ref. 1).
2. Why and how in atomic spectra of hydrogen atom, there are found several series of spectral lines, e.g., Lyman series, Balmer series, Paschen series etc., not a single series (see Sec. III D, Ref. 1);
3. How and why the orbiting electrons acquire elliptical orbits despite moving in spherically symmetric field (see Sec. III C, Ref. 1). [The orbiting electrons move actually in elliptical orbits (as all the planets of our solar system move in elliptical orbits) not in circular orbits. The Bohr's theory fails to explain accurately the frequency of higher order spectral lines of every series (Lyman series, Balmer series etc.) because, in this theory, the motion of electrons has been assumed in circular orbits. Somehow, if assuming elliptical orbits for the orbiting electrons, the expression for the frequency of spectral lines is deduced, that shall explain accurately the frequency of higher order spectral lines of every series.]

4.1.1 (b) Current explanation, and faults in it

The current theories enable to deduce the expression for frequency of spectral lines but fail to deduce the expression for intensity of spectral lines. The current theories fail to

explain the decrease in intensity of spectral lines as their frequency increases; decrease in thickness of spectral lines as their order increases and many more phenomena/events

Regarding explanation of fine structure of spectral lines, the existing explanation (given by the current theories) has two very basic and fundamental faults:

1. The determination of μ_j is neither judicious nor meaningful (for detail, see Sec. 1, Ref. 2) because in expression $\mu_j = g_j(-e/2m)L_j$ where g_j is known as the Lande g factor, L_j = jh /2π is not true (for detail, see Sec. 1, Ref. 2).

2. j (= s $\pm$ l) can have only one value corresponding to each value of l, not more than one value (for detail, see Sec. 1, Ref. 2).

Therefore, the existing explanation of fine structure of spectral lines cannot be set forth to be true.

Secondly, the theories existing to explain the fine structure of spectral lines fail to explain as to why and how the fine structures of spectral lines are obtained. These theories somehow manage to give only the number of fine lines, that too adopting very complicated and tedious procedure of assigning number of sub-energy states corresponding to different energy states of electron and putting some selection rules for the occurrence of its transition among them. If we look at the procedure followed in these theories to explain the fine structure of spectral lines in different cases, we find that they are not capable even to give the exact number of fine lines. In order to explain it, further interpretations have been presented [for detail, see starting from the last paragraph (column-1, page-66) to paragraph-4 (column-2, page-66) of Sec. III M, Ref. 1].

4.1.2 Explanation of quantum mechanical phenomena

How the account of the generated two properties enables to explain the quantum mechanical phenomena, let us take, e.g., the phenomenon, transmittance T = finite for particles possessing energy $E < V_0$, where V_0 is energy of the potential barrier [see Sec. 4.1.2 (a)]. The current explanation of the phenomenon, T = finite for particles possessing energy $E < V_0$, where the wave nature of particles has been assumed instead of taking the account of two properties generated in them due to their spin motion, has also been discussed [see Sec. 4.1.2 (b)].

4.1.2 (a) Present explanation (i.e. taking account of the generated two properties in particles**) of the phenomenon, transmittance T = finite for particles possessing energy** $E < V_0$

Since all the quantum mechanical particles possess spin motion, obviously they possess spin energy (E_s). And hence their total energy E should be $= E_k + E_s = E_m$, not equal to E_k. Then their total energy $E (= E_m)$ should be $> E_k$, and hence may be > V_0. Consequently the particle penetrates into the barrier, i.e. T = finite is obtained.

Further, for penetration of any particle into/through a potential barrier, it is necessary that the particle possesses momentum, and the magnitude of momentum should be such that the energy of particle corresponding to this momentum is greater than the energy of the potential barrier. Since the spin motion of particle generates spin momentum (p_s) and E_s both in it, the momentum of the particle is also increased from p_{lin} to p_m (= $p_{lin} + p_s$) in addition to increase in its energy from E_k to E_m (= $E_k + E_s$). Therefore the

particle succeeds to penetrate into/through the barrier and T = finite is obtained (for detail, see Sec. II, Ref. 1).

4.1.2 (b) Current explanation (i.e. assuming wave nature of particles**), and faults in it**

In the current explanation, it is claimed that the property of barrier penetration is entirely due to the wave nature of particles and is very similar to the total internal reflection of light waves. If two glass plates are placed close to each other with a film of air as medium between them, some light is transmitted from one plate to another even though the angle of incidence is greater than the critical angle. But, in the case of transmittance of light through the air film, some light is transmitted even though the angle of incidence is greater than the critical angle, while in the case of transmittance of matter particles through the potential barrier, T = finite is obtained even though their energy $E < V_0$, how can these be similar? In the case of transmittance of matter particles, we are talking about the dependence of their transmittance over their energy while in the case of transmittance of light, we are talking about the dependence of their transmittance over their angle of incidence, how can these be compared?

The claim that the intensity of transmitted light decreases exponentially with increase in thickness of the air film similarly as T decreases exponentially with increase in thickness of potential barrier (as obtained in the mathematical treatment of explanation of T = finite) can of course be accepted. But it does not approve the claim that the property of barrier penetration is due to the wave nature of particles. Because:

1. Does the wave nature of particles generate momentum in them and increase their momentum to $p'(> p_{lin})$ such that the energy corresponding to this momentum (i.e.

p') is greater than the energy V_0 of the potential barrier? Otherwise, the particles cannot penetrate through the barrier, i.e. T = finite for particles $E < V_0$ cannot be obtained.

2. To explain the phenomenon of photoelectric effect, in order that the photons may penetrate into the metals, energy $h\nu$ and momentum $h\nu/c$ have been associated with photons, while to explain T = finite for particles $E < V_0$, it is claimed that this phenomenon occurs due to the wave nature of particles. It is amazing.
3. The assumption of wave nature of particles is not true [see Sects. 2.1.1 (b) and 3, Ref. 4]. And the phenomena of interference and diffraction of photons and electrons, to explain which the wave nature of photons and electrons has been assumed, take place due to particle nature of photons and electrons (see Sects. 4.2.1, 4.2.2, 4.2.3, Ref. 4), not due to their wave nature.

4.1.3 Explanation of the phenomena of interference and diffraction of photons and electrons

4.1.3 (a) Present explanation (i.e. taking account of the generated two properties in electrons and photons**)**

The account of the generated two properties in photons enables to give very clear and complete explanation as to why and how the phenomena of their interference and diffraction take place.

4.1.3(a1) Explanation of the phenomenon of interference

1. For the explanation of the phenomenon when the source of light is monochromatic, see Sects. 4.2.2(a), and 4.2.2(c), Ref. 4.

2. For the explanation of the phenomenon when the source of light is non-monochromatic, say of white light, see Sec. 4.2.2(b), Ref. 4.

4.1.3(a2) Explanation of the phenomenon of diffraction

I. Diffraction at straight edge

i. For the explanation of why and how the intensity falls off continuously and rapidly into the geometrical shadow until complete darkness is reached, see Sec 4.2.3 (a1), Ref. 4.

ii. For the explanation of why and how the bright and dark bands are obtained outside the geometrical shadow, see Sec. 4.2.3(a2), Ref. 4.

iii. For the explanation of why and how the bright bands of continuously reducing intensity and width, as their order increases are obtained, see Sec. 4.2.3(a3), Ref. 4.

iv. For the explanation of why and how after every bright band, a dark band is obtained and the darkness and the width of that dark band go on continuously reducing as that's order increases, see Sec. 4.2.3(a4), Ref. 4.

II. Diffraction at a narrow wire

1. For the explanation of why and how the diffraction bands of decreasing intensity of brightness and width are obtained on both sides of the limits of the geometrical shadow similar to those as are obtained outside the limit of straight edge, see Sec. 4.2.3(b1), Ref. 4.

2. For the explanation of why and how interference fringes are obtained inside the geometrical shadow of the wire, see Sec. 4.2.3(b1), Ref. 4.

3. For the explanation of why and how the interference fringes inside the geometrical shadow are disappeared when the wire happens to be thick, see Sec. 4.2.3(b2), Ref. 4.

III. Diffraction at a single slit

For the explanation of why and how very bright and wide central band is obtained, and on both sides of it, symmetrically few bands of rapidly decreasing brightness are obtained; see Sec. 4.2.3(c), Ref. 4.

4.1.3 (b) Current explanation (i.e. assuming wave nature of photons and electrons**), and faults in it**

In the current explanation:

1. The current interpretation of photon is faulty and incomplete; see Sec. 2.1.1, Ref. 4.

2. The assumption of wave nature of photons and electrons is not true, see Sects. 2.1.1(b), 3.1 and 3.3, Ref. 4.

3. The expression of de Broglie wavelength is faulty, see Sec. 3.2, Ref. 4.

4. In the explanation of the phenomena of interference and diffraction, there are very basic and fundamental faults; see Sec. 4.1, Ref. 4.

4.1.4 Explanation of relativistic phenomena

How the account of the generated two properties in electrons etc. enables to explain the relativistic phenomena related with them, let us take, e.g., the phenomenon of variation of velocity of electrons accelerated by a large voltage, with their kinetic energy, see Sec. 4.1.4 (a). The current explanation of the above phenomenon has also been discussed in Sec. 4.1.4 (b). In the current explanation, instead of taking the account of the generated two properties in electrons, it has been assumed that when the electrons are accelerated by a large voltage and the rate of increase in their velocity starts decreasing after attaining relativistic velocity by them, the moving mass of electrons starts increasing in order to conserve their E_k and p_{lin}.

4.1.4 (a) Present explanation (i.e. taking account of the generated two properties in electrons**) of the variation of velocity of electrons with their kinetic energy**

When the electron is accelerated by a large voltage up to $15\times10^{6}V$ (Bertozzi's experiment[9]) and the rate of increase in its velocity (v) starts decreasing after attaining relativistic velocity by it, it's moving mass does not start increasing in order to conserve its E_k and p_{lin} [for detail, see Sec. 4.1.4(b)]. Instead the rate of increase in frequency of its spin motion (ω) starts increasing in order to conserve its E_m, p_m and L_s. Because electron possesses E_m, p_m, L_s and hence its E_m, p_m, L_s should be conserved. [How, E_m, p_m and L_s of electron conserve due to increase in the rate of increase in its ω, see Sec. 4.1.4(a1). And for evidence to verify that the rate of increase in ω of electron starts increasing in order to conserve E_m and p_m of electron, see Sec. IV C 1, Ref. 1.]

Since the electron possesses energy $E_m = E_k + E_s$ and momentum $p_m = p_{lin} + p_s$, if superposing the effects of E_s and p_s of electron on its E_k (= m_e v^2/2) and p_{lin} (= m_e v) respectively we try to write down the expressions for E_m and p_m of electron in the form/terms of its kinetic energy and linear momentum respectively, the expressions are obtained as: E_m = (m_e)$_{\text{eff}}$ v^2/2 and p_m = (m_e)$_{\text{eff}}$ v respectively. The energy (m_e)$_{\text{eff}}$ v^2/2 and the momentum (m_e)$_{\text{eff}}$ v shall produce the same effects as the energy E_m and the momentum p_m respectively shall produce. The term (m_e)$_{\text{eff}}$ is the effective mass of electron.

The moving mass $m_{mov} = m_e / \sqrt{(1-\text{v}^2/c^2)}$ (where m_e is the rest mass of electron), the relativistic kinetic energy $E_k = [m_e c^2 / \sqrt{(1-\text{v}^2/c^2)}] - m_e c^2$ and the relativistic linear

momentum $p_{lin} = m\mathrm{v}/\sqrt{(1-\mathrm{v}^2/c^2)}$ of electron are actually its effective mass $(m_e)_{\text{eff}}$, E_m [= $(m_e)_{\text{eff}}$ v $^2/2$] and p_m [= $(m_e)_{\text{eff}}$ v] respectively. How the expressions $E_k = [m_e c^2/\sqrt{(1-\mathrm{v}^2/c^2)}] - m_e c^2$ and $p_{lin} = m\mathrm{v}/\sqrt{(1-\mathrm{v}^2/c^2)}$ are obtained as the consequence of superposition of the effects of E_s and p_s of electron on its E_k and p_{lin} respectively, see starting from the last but one paragraph (column-1, page-69) to second paragraph (column-2, page-70, i.e., the end of Sec. IV C) of Sec. IV C, Ref. 1.}

4.1.4 (a1) Explanation of how L_s , E_m and p_m of electrons conserve

When ω of electron increases as its v increases, the increase in ω of electron is caused due to shrink in its size, i.e. due to decrease in its volume. Because, when the volume of electron is decreased, obviously its radius (r) is reduced and that causes decrease in its moment of inertia I (= $m_e r^2$). The decrease in I of electron causes decrease in L_s (= $I\, d\theta/dt$, where $d\theta/dt$ is the angular velocity of its spin motion) of electron. Therefore, in order to conserve L_s of electron, $d\theta/dt$ of electron is increased and that causes increase in ω of electron. The increase in ω of electrons causes increase in E_s and p_s of electrons, and that (i.e. increase in E_s and p_s of electrons) conserve respectively their E_m and p_m .

The concept of shrink in size of electron cannot be ruled out because protons, which are particles like electrons, shrink in size[10]. Secondly, we observe that, as we proceed towards the photons of frequencies (ν) higher than the photons of visible region, the photons start penetrating and the power of their penetration goes on increasing as their ν increases. No doubt, as their ν increases, their momentum ($h\nu/c$) increases and consequently their power of penetration increases, but the rate of increase in their power

of penetration happens to be probably faster. It may happen because photons also shrink in their size, and as ν of photons increases, shrink in their size goes on increasing, and that increases the rate of power of their penetration more.

4.1.4 (b) Current explanation (i.e. assuming that after attaining relativistic velocity by the electron, its moving mass starts increasing in order to conserve its E_k and p_{lin} **), and faults in it**

Currently, it is assumed that when the electrons are accelerated by a large voltage, after attaining relativistic velocity by them, their moving mass starts increasing in accordance to expression $m_{mov} = m_e / \sqrt{(1 - \mathrm{v}^2 / c^2)}$ in order to conserve their E_k and p_{lin}. But this assumption cannot be true because it gives rise to several very fundamental questions (see Sec. IV C, Ref. 1). Two of them are as follows:

i. Since the electron possesses spin motion, it should possess E_m, p_m, and L_s. And further, since the frequency ω of spin motion of electron varies with its velocity v (see Sec. 2.1.2), after attaining relativistic velocity by it when the rate of increase in its v starts decreasing, E_m, p_m and L_s of electron should be conserved, not its E_k and p_{lin}. Can E_m, p_m, L_s of electron conserve by increasing in its moving mass? And if can conserve, how?

ii. The evidence we have from experiments proving the existence of electrons suggests an indivisible entity having definite quantities associated with it: e and m_e. Then how can m_e increase? Suppose if it is argued that when the rate of increase in v of electron starts decreasing, it's moving mass increases, not it's rest mass m_e, this

argument cannot be accepted because it gives rise to several questions for which no explanation can be given. For example: What moving mass actually is? What is its physical interpretation? Further, as the name it has “moving mass”, it should start decreasing when the rate of increase in the velocity of electron starts decreasing after attaining relativistic velocity by it, while on the contrary, the moving mass of electron starts increasing. How?

4.2 Importance of the accounts of both, the generated two properties and the generated force

The account of the generated two properties in electrons due to their spin motion together with the account of the generated force between electrons due to interaction between their magnetic fields enable to explain all the phenomena, properties and effects etc. related with electromagnetism (see Sec. 4.2.1) and superconductivity (see Sec. 4.2.2). And the account of the generated two properties in nucleons due to their spin motion together with the account of the generated force between nucleons due to interaction between their magnetic fields enable to explain all the nuclear phenomena, properties and nuclear structure etc. (see Sec. 4.2.3).

4.2.1 Explanation of the phenomenon of electromagnetism and of the related properties

4.2.1 (a) Present explanation (i.e. taking accounts of the generated two properties in electrons and the generated force between electrons**)**

The accounts of the generated two properties in electrons and the generated force between electrons enable to give almost a complete understanding of:

1. How electromagnetism is generated in a current carrying rod (see Sec. 4.1, Ref. 2).

2. Which type of magnetism (electromagnetism) is generated in the current carrying rod (see Sects. 4.2. and 4.3, Ref. 2).

3. How a magnetic field is generated around the current carrying rod in a plane perpendicular to the direction of flow of current through the rod and how that (magnetic field) possesses direction (see Sec. 4.1, Ref. 2).

4. How electron possesses persistent spin motion, magnetic field around it and spin magnetic moment (μ_s) [see Sec. 3.1].

5. How a magnetic field is generated around the electron orbit such that there are generated north and south poles and the orbit behaves like a magnetic dipole (see Sec. 5.1, Ref. 2).

6. How magnetic north and south poles are generated in current carrying closed loops and the loops behave like magnetic dipoles (see Sec. 5.2, Ref. 2).

4.2.1 (b). Current explanation, and faults in it

Currently, there is no explanation as to:

i. How electromagnetism is generated in a current carrying rod, and which type of this generated magnetism happens to be

ii. How a magnetic field is generated around the rod in a plane perpendicular to the direction of flow of current through the rod.

iii. How that generated field possesses direction.

Currently, it has merely being assumed that due to flow of charge of electron through the rod, electromagnetism is generated in the rod and a magnetic field is generated

around the rod and that is all. No explanation is found as to how these are generated, how the field is generated in a plane perpendicular to the direction of flow of current through the rod and how that field possesses direction. (For detail, see Sec. 1, Ref. 2.)

Currently, there is also no explanation as to:

i. How the electron possesses persistent spin motion.

ii. How the electron possesses a magnetic field around it and spin magnetic moment (μ_s) due to spin motion of its charge.

iii. How a magnetic field is generated around the orbital path of electron and the orbit behaves like a magnetic dipole possessing orbital magnetic moment (μ_l).

Currently, it has merely being assumed that the electron possesses persistent spin motion, a magnetic field around it and spin magnetic moment (μ_s) due to spin motion of its charge, and the electron orbit behaves like a magnetic dipole possessing orbital magnetic moment (μ_l). [For detail, see Sec. 1, Ref.2.]

4.2.2 Explanation of the phenomenon of superconductivity, related properties and effects

4.2.2 (a) Present explanation (i.e. taking accounts of the generated two properties in electrons and the generated force between electrons**)**

The accounts of the generated two properties in electrons and the generated force between electrons enable to give almost a complete understanding of:

1. Why and how superconductivity is generated (see Sec. 4, Ref. 3).

2. Why and how the entropy at superconducting state of the substance decreases (see Sec. 5.1, Ref. 3).

3. Variation of transition temperature (T_c) from substance to substance (see Sec. 5.2, Ref. 3).

4. Why and how the substances like Cu and Au etc. do not superconduct even down to very low temperatures (see Sec. 5.3, Ref. 3).

5. How Meissner effect takes place and how a magnet is levitated above a superconductor (see Sec. 5.4, Ref. 3).

6. Why and how diamagnetism generated in substances at their superconducting state persists, while generated at normal state does not persist (see Sec. 5.5, Ref. 3).

7. No occurrence of superconducting state in ferromagnetic substances (see Sec. 5.6, Ref. 3).

8. i. How normal state of specimen is restored applying an external magnetic field H_c across it at its superconducting state (see Sec. 5.7.1, Ref. 3). ii. Why H_c increases as temperature of specimen decreases beyond its T_c (see Sec. 5.7.2, Ref. 3). Iii. Why H_c varies from substance to substance (see Sec. 5.7.3, Ref. 3).

9. i. Why and how thermal conductivity of the specimen is discontinuously increased when superconducting state of the specimen is destroyed by the application of an external magnetic field H_c (see Sec. 5.8.1, Ref. 3). ii. Why and how thermal conductivity of specimen changes continuously between its two phases, and how at superconducting phase, it is found to be lower (see Sec. 5.8.2, Ref. 3).

10. i. Energy gap between electrons at normal state and electrons at superconducting state of the specimen (see Sec. 5.9.1, Ref. 3). ii. Why energy of electrons goes on decreasing as temperature of the specimen decreases below T_c (see Sec. 5.9.2, Ref. 3).

11. Josephson's Tunneling (see Sec. 5.10, Ref. 3).

12. Latent heat of transition (see Sec. 4.11, Ref. 3).

13. Why and how the specific heat of specimen is discontinuously increased when the temperature of the specimen is brought down to its T_c (see Sec. 4.12, Ref. 3).

4.2.2 (b) Current explanation (i.e. assuming wave nature of electrons**), and faults in it**

To explain as to how superconductivity and properties, effects etc. exhibited by superconductors are generated, several theories have so far been proposed.

For BCS (Bardeen–Cooper–Schrieffer) theory[11] it is claimed that it provides better quantum explanation of superconductivity and accounts very well for all the properties exhibited by the superconductors. The BCS theory no doubt provides better quantum explanation of superconductivity and accounts very well for all the properties exhibited by the superconductors, but if we examine the BCS theory and its rigorous mathematical proofs closely and intently, we find that it is based on such concepts which are practically not possible and contradict two well-observed facts too (see Sec. 6, Ref. 3). These concepts have been taken keeping in view that these may give the desired results. No thinking has been focused over whether these are logically and/or practically possible or not. Consequently these concepts give rise to numerous very basic and fundamental questions (see Sec. 6, Ref. 3). But instead of realizing the truth, several assumptions have further been taken in order to justify the taken concepts (see Sec. 6, Ref. 3). These assumptions too are

not true and give rise to numerous more very basic and fundamental questions (see Sec. 6, Ref. 3). Most importantly, the taken assumptions cannot be avoided otherwise the BCS theory fails to give the desired results

Secondly, the BCS theory does not explain all the properties exhibited by the superconductors. It fails to explain several very important properties.

4.2.3 Explanation of nuclear phenomena, structures and properties of deuterons, alpha particles nuclei

4.2.3 (a) Present explanation (i.e. taking accounts of the generated two properties in nucleons and the generated force between nucleons**)**

The account of the generated two properties enables to give almost a complete understanding of neutron structure (see Sec. 2, Ref. 8) and its properties, e.g.:

1. Mean life time (t) of neutron (see Sec. 3.1, Ref. 8).
2. Why and how time t happens to be about 15 minutes (see Sec. 3.2, Ref. 8).
3. Why and how neutron has both stable and unstable states (see Sec. 3.3, Ref. 8).
4. Magnetic moment of neutron (see Sec. 3.4, Ref. 8).
5. Electric dipole moment of neutron (see Sec. 3.5, Ref. 8).
6. While it is believed that the electrons do not reside inside the nuclei then how electrons are emitted from the nuclei during β decay (see Sec. 3.6, Ref. 8);
7. Why and how beta particles emitted from radioactive sources have continuous energy spectrum (see Sec. 3.7, Ref. 8).
8. Why and how the neutron has high penetrating power (see Sec. 3.8, Ref. 8).

9. Why and how the neutron has distinguishable low and high energy ranges (see Sec. 3.9, Ref. 8).

The accounts of the generated two properties in nucleons and the generated force between nucleons enable to give almost a complete understanding of structures and properties of deuterons, alpha particles and nuclei. For example:

1. How neutron becomes stable in system, deuteron (see Sec. 4.1, Ref. 6).

2. Why and how deuteron (*NP*) only exists in nature, not the systems di-proton (*PP*) and di-neutron (*NN*) (see Sects. 4.2 and 4.3, Ref. 6).

3. Why and how due to the addition of one *P* in system *NN*, the resultant system, i.e. the nucleus of H^3 becomes stable, while the system *NN* is not stable (see Sec. 5.1, Ref. 6).

4. Why and how the binding energy per nucleon (E_b) of the resultant system (nucleus of H^3) becomes $> 2\times(E_b)_D$ (see Sec. 5.2, Ref. 6).

5. Why and how due to the addition of one *N* in system *PP*, the resultant system, i.e. the nucleus of He^3 becomes stable, while the system *PP* is not stable (see Sec. 5.3, Ref. 6).

6. Why and how E_b of the resultant system (nucleus of He^3) becomes $> 2\times(E_b)_D$ (see Sec. 5.4, Ref. 6).

7. Why and how $(E_b)_{H^3}$ happens to be > $(E_b)_{He^3}$ (see Sec. 5.5, Ref. 6).

8. Despite $(E_b)_{H^3} > (E_b)_{He^3}$, why and how H^3 happens to be radioactive and decays into He^3 through β decay (see Sec. 5.6, Ref. 6).

9. How two-neutrons and two-protons are arranged in an alpha particle such that its nucleons become so strongly bound together that it starts behaving like a particle, and how

beams of alpha particles are obtained despite having repulsive Coulomb force between them (see Sec. 6.1, Ref. 6).

10. Why and how E_b of α particle is increased to > $6\times(E_b)_D$ instead of increasing to $2\times(E_b)_D$ (see Sec. 6.2, Ref. 6).

11. How nucleons are arranged in nuclei having mass number A = integer multiple of 4 (e.g. nuclei of He^4, Be^8, C^{12}, O^{16}, Ne^{20}, Mg^{24} etc.) such that they (nuclei) are most strongly stable and how their E_b increases as their A increases in multiple of 4 (see from Sec. 7.1 to Sec. 7.9, Ref. 6).

12. How E_b of Be^8 is reduced to < E_b of He^4 while A of Be^8 = 2×A of He^4 (see. Sec. 7.2.1, Ref. 6).

13. How nucleons are arranged in nuclei having A ≠ integer multiple of 4 (e.g. Li^6, Li^7, B^{11} and N^{14}) such that these are not strongly stable, and how E_b of Li^6 and Li^7 increase as their A increases but are happened to be < E_b of He^4 though A of Li^6 and Li^7 > A of He^4 (see Sec. 8.1, Ref. 6), how nucleons are arranged in the nucleus of B^{11} such that its E_b becomes < E_b Be^8 though A of B^{11} > A of Be^8 (see Sec. 8.2, Ref. 6), how E_b of N^{14} becomes < E_b of C^{12} though A of N^{14} > A of C^{12} (see Sec. 8.3, Ref. 6).

14. Why and how E_b of nuclei, after becoming maximum near A = 62, gradually starts decreasing as A increases (see Sec. 9.1, Ref. 6).

15. Why and how nuclei become radioactive when A > 200 and α and β particles start emitting from them (see Sec. 9.2.1, Ref. 6).

16. How γ (gamma) and ν (neutrino) are emitted from nuclei and how γ and ν obtain particle like physical existence as photons possess (see Sec. 9.2.2, Ref. 6).

17. How γ and ν obtain so high energy and momentum (see Sec. 9.2.3, Ref. 6).

4.2.3 (b) Current explanation, and faults in it

Several neutron models have so far been proposed but they have succeeded to explain hardly few properties of neutrons and phenomena related with them. The quark model though succeeds to give understanding of neutron structure but gives rise to numerous very basic and fundamental questions (see Sec. 3.10 and also Sec. 1, Ref. 8).

Regarding nuclei, several models have also been proposed. But none has been able to give clear picture of how nucleons are arranged in deuterons, alpha particles and nuclei. Regarding their properties too, very little is known.

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